SOFIA Science Newsletter

March 2023

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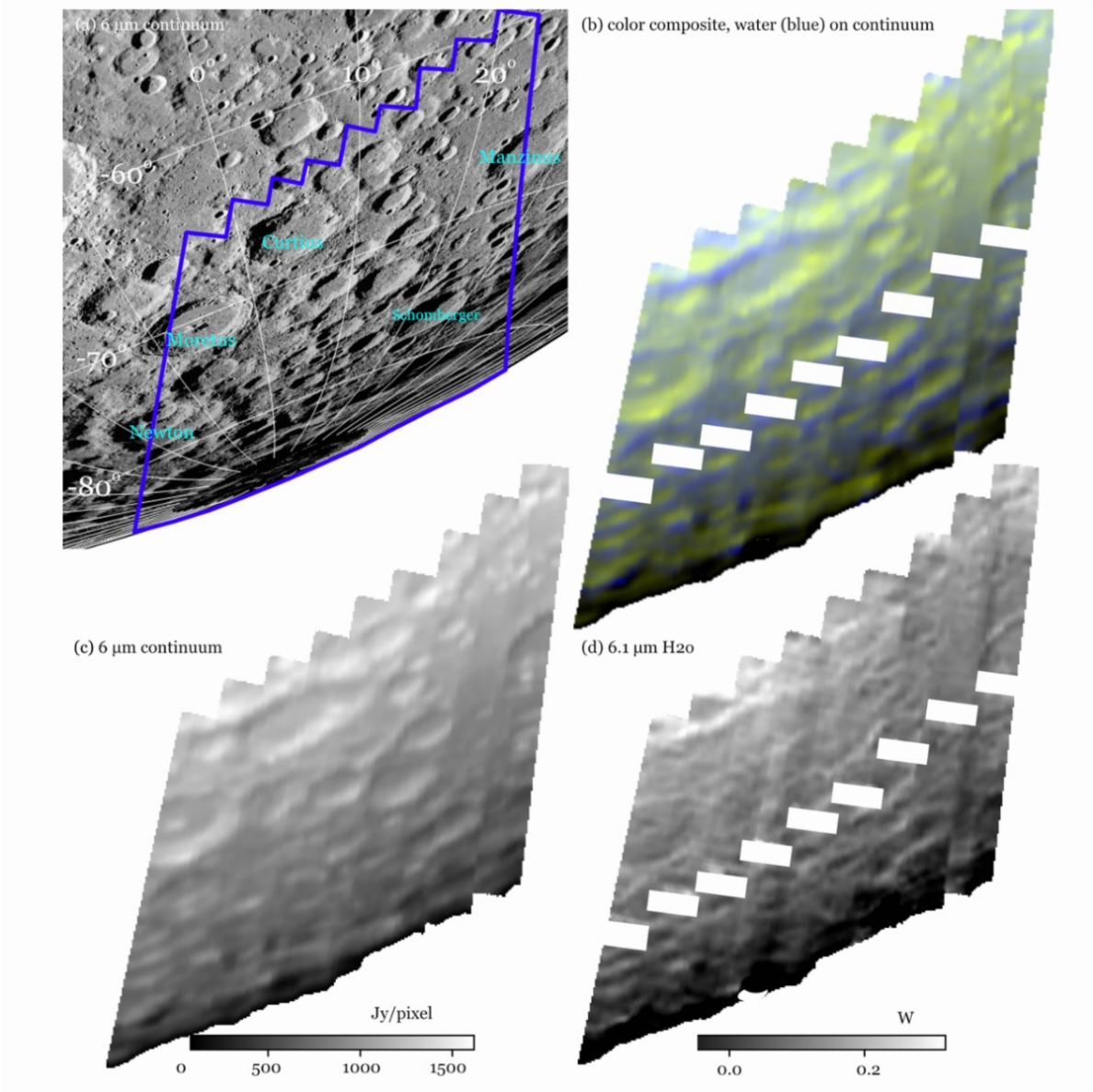
Science Spotlight

Mapping Water on the Lunar Surface

For the first time, SOFIA has made a detailed map of water on the surface of the Moon. Comparison with the lunar landscape shows that the water emission is strongest on the shady sides of deep craters and high mountains. Researchers used observations taken on 2022 February 17 as part of a SOFIA Legacy project intended to explore how water is distributed across the lunar surface.

Interest in lunar water was sparked by discoveries made in the last decade. Evidence for ice close to the South Pole was found by the NASA LCROSS mission, which dropped a rocket booster into a permanent shadow and observed water in the material raised from the surface by the impact. Evidence for widespread hydration came from observations of a 3 micron reflectance feature by the Indian Space Research Organization Chandrayaan-1 mission, which could be explained by hydroxyl (OH) and/or water (H_2O). The 3 micron feature was also imaged by the NASA Deep Impact spacecraft and the ground-based Infrared Telescope Facility (IRTF) in Hawaii. Read more here.



(a) Lunar Reconnaissance Orbiter Wide Angle Camera image of the southern limb of the Moon, oriented with the celestial pole at the top as appropriate for 2022 February 17, with lunar coordinate grid overlaid and an outline of the region observed with SOFIA (blue lines). (b) Color rendition of SOFIA water and continuum emission. The color image combines the 6 micron continuum surface brightness (green) and the 6 micron water feature strength (blue). The diagonal empty regions on the water image mask a partially transparent defect on the surface of the detector that leads to significantly higher noise. (c) The 6 µm continuum surface brightness in Jy/pixel. (d) The 6 micron integrated water band strength, W. Credit: Reach et al., 2023

Science Spotlight

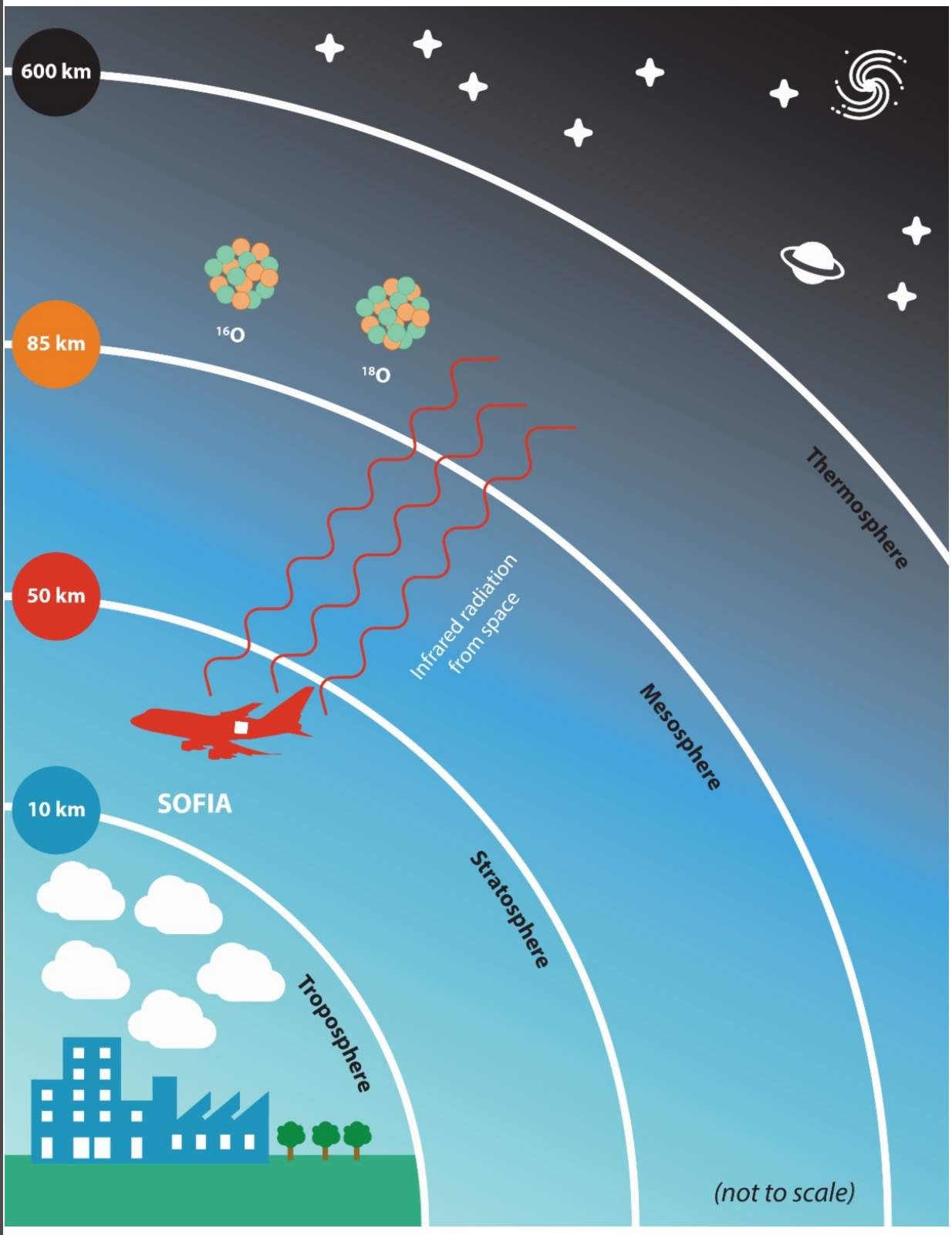
SOFIA Makes First Detection of Heavy Oxygen in Earth's Upper Atmosphere

The Stratospheric Observatory for Infrared Astronomy (SOFIA) made the first-ever measurement of heavy atomic oxygen in Earth's upper atmosphere.

Heavy oxygen is so called because it has 10 neutrons, rather than the normal eight of "main" oxygen, the form we breathe. Heavy oxygen is seen as a signature of biological activity, common in the lower atmosphere. Both forms are byproducts of photosynthesis, but main oxygen is consumed by the respiration of living things more than its heavy counterpart, leaving a larger concentration of heavy oxygen behind.

Little is known, however, about how this abundance of heavy oxygen permeates from the location of its creation near the ground into higher regions of the atmosphere. With its high spectral resolution, SOFIA's GREAT instrument measured the ratio of main to heavy

oxygen in the mesosphere and lower thermosphere, making the first spectroscopic detection of heavy oxygen outside a laboratory. Read more here.



This schematic shows the layers of Earth's atmosphere, from the troposphere to the thermosphere. SOFIA observes from within the stratosphere and studied the ratio of main oxygen to heavy oxygen in the mesosphere and lower thermosphere, up to an altitude of about 124 miles (200 kilometers.) Credit: NASA/SOFIA/L. Proudfit

Registration is Now Open for SOFIA School, April 18-21, 2023

Registration is now open for the second SOFIA School, which will be held this year on April 18-21, 7:30-11 am Pacific Time. This free virtual event is designed for anyone who considers using astronomical mid- and far-IR data in their scientific research. Through scientific-analysis and data-reduction examples paired with lectures on fundamental concepts, attendees will be introduced to the range of scientific information leveraged by such data on a variety of sources. The school will focus on SOFIA data, but the content presented will be relevant to other mid-/far-IR data from balloon facilities or satellites. **Register here.**

AAS Meeting-in-a-Meeting, "On the Wings of SOFIA"

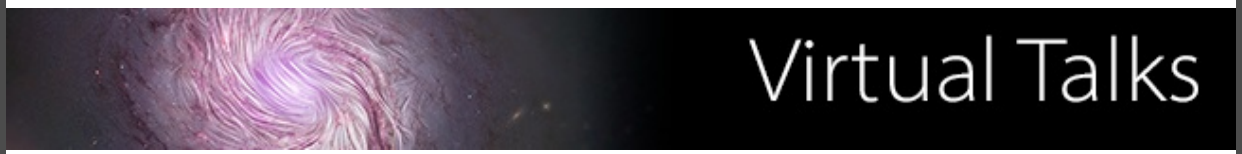
This June there will be a Meeting-in-a-Meeting during the 242nd gathering of the American Astronomical Society (AAS) in Albuquerque, NM entitled, "Standing on the Wings of SOFIA." This event will be a forum to discuss key results from SOFIA's decade-long mission, with topics ranging from the Solar System to distant galaxies, and will explore how the SOFIA legacy can provide a foundation for the FIR Probe concepts currently under development in response to the recommendations by the 2020 Decadal Survey.

This event will consist of five 90-min sessions over three days and will cover four general topics where SOFIA has had a significant impact to the development of infrared astronomy: ISM/Star formation, Magnetic Fields/Dust physics, Galaxy Structure, and Stars/Solar system. The last day will be dedicated to discussion of future far-IR instrumentation and missions, especially the four FIR Probes. Along with invited speakers, there will be an opportunity to present contributed talks and posters.

This Meeting-in-a-Meeting is being organized by B-G Andersson (USRA) and Tommy Wiklind (CUA), together with several USRA and DSI scientist. Please note: for contributed talks and posters, the AAS considers the five sessions as independent. Hence, when submitting an abstract to the Meeting-in-Meeting, please choose from the following in the abstract submission drop-down menu:

- Galactic Ecosystems: ISM & Star Formation
- Galactic Ecosystems: Magnetic Fields and Dust Physics
- Galactic Ecosystems: Galaxy structure and evolution
- New Worlds/Time Domain: Stars and Solar System
- The Future of FIR Astronomy

We look forward to seeing you in Albuquerque!



Join Science Talks Remotely: Tele-Talks

Tele-Talks are scientific presentations given via phone, with slides distributed ahead of time. The talks are held approximately twice a month on Wednesdays at 9:00 a.m. Pacific, noon Eastern. For information on how to participate, check the SOFIA Tele-Talk webpage.

Upcoming Tele-Talks

- March 22: Yue Hu (University of Wisconsin); Characterizing Magnetic Fields's Role in Fueling Seyfert Nuclei With SOFIA/HAWC+, Velocity Gradient, and VLA
- April 5: Darek Lis (NASA JPL); atomic oxygen abundance toward Sagittarius B2
- April 12: Will Surgent (Stanford); quantifying morphology of the ordered magnetic fields in galaxies
- May 10: Randolf Klein (SSC); PDR fronts in M17-SW

Please direct questions and comments to the SOFIA Science Center help desk:
sofia_help@sofia.usra.edu.